TABLE 2.—*Free-air resultant winds (m. p. s.) during December, 1923.*

Altitude, m. s. l. (m.)	Broken Arrow, Okla. (233 meters).				Drexel, Nebr. (396 meters).				Due West, S. C. (217 meters).				Ellendale, N. Dak. (444 meters).				Groesbeck, Tex. (141 meters).				Royal Center, Ind. (225 meters).			
	Mean.		6-year mean.		Mean.		9-year mean.		Mean.		3-year mean.		Mean.		6-year mean.		Mean.		6-year mean.		Mean.		6-year mean.	
	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.	Dir.	Vel.
Surface	S. 88° W.	1.6	S. 51° W.	1.2	S. 69° W.	2.2	S. 86° W.	1.2	S. 49° W.	2.3	S. 55° W.	1.3	N. 66° W.	3.2	N. 56° W.	3.3	N. 36° W.	1.1	N. 87° W.	1.1	S. 54° W.	2.3	S. 50° W.	2.2
250	S. 86° W.	1.6	S. 45° W.	1.4					S. 47° W.	2.6	S. 53° W.	1.6					N. 59° W.	1.3	S. 68° W.	1.5	S. 47° W.	2.9	S. 49° W.	2.5
500	S. 68° W.	2.7	S. 47° W.	3.1	S. 72° W.	3.6	S. 88° W.	2.0	S. 57° W.	3.9	S. 63° W.	3.5	N. 67° W.	3.6	N. 62° W.	3.6	N. 83° W.	2.3	S. 55° W.	3.1	S. 55° W.	6.5	S. 57° W.	5.1
750	S. 67° W.	3.7	S. 51° W.	4.1	S. 89° W.	5.6	N. 78° W.	3.8	S. 59° W.	5.6	S. 70° W.	5.1	N. 62° W.	6.2	N. 60° W.	5.8	S. 78° W.	2.5	S. 54° W.	4.3	S. 64° W.	7.8	S. 66° W.	6.8
1,000	S. 81° W.	4.9	S. 64° W.	4.6	N. 86° W.	6.8	N. 77° W.	5.0	S. 64° W.	7.5	S. 76° W.	6.5	N. 62° W.	6.9	N. 58° W.	7.0	S. 81° W.	5.6	S. 56° W.	5.6	S. 76° W.	9.2	S. 78° W.	8.0
1,250	S. 81° W.	5.5	S. 78° W.	4.9	N. 77° W.	7.6	N. 76° W.	5.7	S. 65° W.	8.4	S. 75° W.	7.7	N. 66° W.	7.3	N. 58° W.	7.7	S. 79° W.	6.6	S. 63° W.	6.5	S. 85° W.	10.0	S. 83° W.	9.8
1,500	S. 79° W.	6.3	S. 81° W.	5.5	N. 81° W.	7.7	N. 78° W.	7.1	S. 70° W.	10.0	S. 83° W.	8.8	N. 65° W.	7.9	N. 59° W.	8.6	S. 74° W.	6.2	S. 65° W.	7.3	W.	10.9	S. 87° W.	10.9
2,000	S. 84° W.	5.6	S. 85° W.	6.7	N. 88° W.	9.0	N. 80° W.	8.8	S. 74° W.	11.0	S. 86° W.	10.2	N. 62° W.	9.2	N. 61° W.	9.9	S. 74° W.	7.7	S. 71° W.	8.5	N. 89° W.	13.1	N. 89° W.	12.4
2,500	S. 89° W.	8.0	N. 89° W.	9.4	N. 70° W.	9.6	N. 78° W.	11.2	S. 76° W.	10.5	N. 88° W.	11.7	N. 62° W.	10.0	N. 64° W.	11.8	S. 86° W.	9.1	S. 77° W.	9.6	N. 86° W.	14.0	N. 87° W.	13.4
3,000	S. 68° W.	9.6	N. 88° W.	11.1	N. 80° W.	12.9	N. 80° W.	13.3	S. 75° W.	10.2	N. 87° W.	14.0	N. 55° W.	11.0	N. 68° W.	13.0	S. 83° W.	11.6	S. 74° W.	11.4	S. 73° W.	11.7	S. 85° W.	13.5
3,500	S. 63° W.	10.6	S. 88° W.	11.8	N. 79° W.	13.6	N. 83° W.	15.1	S. 83° W.	14.6	W.	13.8	N. 57° W.	15.4	N. 74° W.	14.9	S. 78° W.	13.1	S. 74° W.	12.0	S. 68° W.	14.9	S. 84° W.	11.3
4,000	S. 71° W.	9.9	W.	10.4	N. 79° W.	11.2	N. 85° W.	16.5	S. 80° W.	14.0	N. 88° W.	12.7	N. 66° W.	15.2	N. 75° W.	14.7	N. 89° W.	14.4	S. 75° W.	11.5	.....	.....	.....	.....
4,500	N. 80° W.	11.3	N. 80° W.	12.4	N. 45° W.	13.0	N. 70° W.	17.6	S. 77° W.	16.0	N. 88° W.	14.0	N. 67° W.	17.8	S. 81° W.	15.8	N. 89° W.	16.3	N. 88° W.	12.0	.....	.....	.....	.....
5,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	N. 45° W.	21.2	N. 89° W.	14.9	N. 81° W.	20.0	N. 83° W.	14.7	.....	.....	.....	.....

THE WEATHER ELEMENTS.

By P. C. DAY, Meteorologist, in Charge of Division.

PRESSURE AND WINDS.

The outstanding feature of the weather during December, 1923, was the persistence of unusual warmth over the districts from the Rocky Mountains eastward, both in Canada and the United States.

This was brought about mainly through the large number of high-pressure areas entering the United States along the Oregon and California coasts, their slow rate of movement over the middle Plateau and Rocky Mountain regions, and their far southward drift in passing thence eastward to the Atlantic coast. This resulted in most low-pressure areas passing eastward north of the International Boundary, with resultant southerly winds over nearly all districts from the Great Plains eastward to the Atlantic coast.

Not until near the end of the month did a fully-developed anticyclone of the Alberta, or usual winter, type, overspread the country.

Late in the month pressure began to rise in Alaska reaching nearly 31 inches at Eagle, near the Arctic Circle, on the 28th and 29th, with temperatures 50° or more below zero. By the morning of the 30th this anticyclone had overspread the Canadian Northwest and was central over southern Alberta, Canada, and northern Montana, attended by severe cold, the temperature on the following morning reaching an extreme low reading of 53° below zero in Montana.

During the closing day of 1923 the anticyclone moved southeastward to the middle Plains, and by the first day of the new year its influence had extended into practically all parts of the country from the Rocky Mountains eastward, attended by the coldest weather of the month from Montana, the Dakotas and Minnesota, southward to the Rio Grande and the West Gulf coast.

As stated previously many of the cyclones of the month passed eastward over southern Canada, and as is usual in such cases the storms were mainly unimportant in their effect upon the weather of the United States as to precipitation, but they did induce relatively warm southerly winds far to the northward of their usual winter limits.

The first important cyclone of the month appeared in the far Southwest early in the month, and moving eastward gave mostly light precipitation over the southern mountain and Great Plains districts, reaching the lower Mississippi Valley by the morning of the 4th, at which time rain had become heavy near the center. During the following two or three days the storm moved slowly toward the lower Lakes and St. Lawrence Valley, increasing greatly in severity and attended by precipitation, mostly rain, over practically all districts from the Mississippi River eastward. Heavy rains occurred during this storm over many portions of the Gulf States, Ohio Valley, and Atlantic coast States, particularly in southern New England.

A cyclone, indifferently outlined, appears to have moved from the far West to the southern Plains by the morning of the 9th and to the west Gulf coast during the following 48 hours, attended by local rains or snows. Immediately following this another storm moved into southern Arizona and during the 10th and 11th overspread the southern mountain and Plateau States, attended by unusually heavy snow and high winds over New Mexico and portions of adjacent States. Drifting snow completely tied up automobile traffic, nullified railroad schedules, and cold weather over the same districts immediately following caused a number of deaths from freezing and much suffering to automobilists and others unable to reach shelter.

The middle portion of the month was mainly free from stormy conditions, but beginning about the 20th moderately low pressure developed in the far Southwest and extending northeasterly toward the Great Lakes gave more or less scattered precipitation over extensive areas to the eastward during the first half of the last decade. The amounts of precipitation were mostly small, however, save over the Gulf States and Ohio Valley where, toward the end of the period, they were more general and frequently heavy.

A moderately well-defined cyclone entered the far Northwest on Christmas Day, and with more or less definite character moved to the lower Missouri Valley by the morning of the 27th and thence to the St. Lawrence Valley and Canadian Maritime Provinces by the 29th. This was likewise attended by widely scattered precipitation, though mostly light, with some snow over the more northern districts.

Immediately preceding the main anticyclone of the month, low pressure developed over Colorado and vicin-

ity, and over the middle Mississippi Valley, immediately to the southward and southeastward of the cold polar front advancing southward from Canada. That portion to the southward was apparently overcome and dissipated by the rapidly advancing anticyclone, but the storm to the southeastward moved to the eastward of the Great Lakes by the close of the year, attended by a wide area of precipitation, mostly light except in portions of the Ohio Valley, with snow over the northern districts and rains to the southward.

The average sea-level pressure for the month was highest, about 30.25 inches, over the middle Plateau and lowest, slightly less than 30 inches, along and to northward of the Canadian border. Compared with the normal, the average pressure was below as a rule over the districts east of the Rocky Mountains in both Canada and the United States, although along the South Atlantic coast there was a small area with averages slightly above. West of the Rocky Mountains the average pressure was nearly everywhere above normal. The departures both above and below normal were not excessive in any section.

Compared with the preceding month the average pressure was higher in the Southeastern States, and generally over a broad area extending from Minnesota and the Dakotas southwestward to California and Arizona. The average pressure was lower than in November from Texas northeastward to New England, and over a small area in the far Northwest, including the adjacent regions of Canada. As a rule the average pressure for December is higher than that for November over all parts of the United States, save in New England and the far Northwest.

TEMPERATURE.

As stated previously the outstanding weather feature of December, 1923, was the persistent warmth, for a winter month, over all districts of the United States and Canada to eastward of the Rocky Mountains.

From the first of the month until near the middle temperature changes were mainly small, and unusually warm weather prevailed on the whole over all districts save in portions of the Southwest and far West.

In New Mexico and adjacent States severe cold set in about the 10th, following an unusual snowstorm, and it continued cold in that district for the following two weeks. Night temperatures were at times near or below zero in the protected valleys and reached extremes of 20° or more below zero in the mountains. The average daily temperatures during this period ranged from 10° to more than 30° below normal, causing a number of deaths and much suffering among those not prepared for such unusual temperatures.

About the 13th cold weather overspread the northwestern districts, and moving eastward brought the lowest temperatures of the month over many of the States to eastward of the Mississippi River. Higher temperatures quickly followed this short cold period, and unusual warmth prevailed almost continuously in all districts, save in portions of the Southwest and far West, until near the end of the month.

On the 29th an anticyclone of marked strength, accompanied by severe cold, moved southward to the upper Missouri Valley and during the following two days advanced into the Great Plains and central valleys, and at the close of the year much of the country east of the Rocky Mountains was experiencing the coldest weather of the winter to that time.

For the month as a whole a new standard of warmth was established over portions of the Middle Atlantic States, where the averages for the month were the highest in more than 50 years. In many portions of the Mississippi Valley and to the eastward the temperature was above normal every day of the month save one or two and but for the cold wave at the end the monthly averages would have exceeded those for the same months of 1877 and 1889, the only two months of that name in the past 50 years with temperatures nearly approaching or exceeding those of December, 1923, over the districts from the Rocky Mountains eastward.

In the more western portions of the country the month as a whole was colder than normal. This was particularly true of New Mexico and portions of adjoining States, in the Yellowstone Park, and over much of the Plateau region, and in northern California, where the weather was mostly colder than normal and in some localities it was among the coldest Decembers of record.

The continued warmth permitted some vegetable growth throughout nearly the entire month, and as late as Christmas Day, and in fact even to the end of the month in the more eastern districts, hardy plants like dandelions, pansies, and others in protected places were in bloom as far north as New York and the Ohio River Valley.

The warmest periods were not confined to large areas on particular dates, but occurred on numerous dates in the different sections. They occurred about the 4th–7th over much of the Mountain, Plateau, and Pacific coast States; about the 7th–10th over the Gulf States and Ohio Valley; from the 16th–22d from the Dakotas and Nebraska eastward to New England; and even on the last day of the month, just preceding the severe cold, at points in the Middle Gulf States.

The coldest periods of the month were mainly on the 14th and 15th over the Gulf States, Ohio Valley and to the eastward, although locally in the lower Mississippi Valley the 6th and 7th were the coldest days. West of the Mississippi the lowest temperatures of the month occurred mainly on the 31st. The lowest temperature observed during the month was 53° below zero on the 31st at Kinread in north-central Montana. At Cheyenne, Wyo., the lowest temperature, −28° on the 31st, was within a fraction of a degree the coldest ever observed at that place in December, and a minimum temperature of −39° at Yellowstone Park was the lowest ever observed in December at that place in a period of 35 years.

PRECIPITATION.

Considering the country as a whole, it was about evenly divided between regions having an excess of precipitation and those having a deficiency.

In the main, precipitation was above the normal over the Southern States from Arizona to Georgia, in the Ohio and portions of the middle Mississippi Valleys, over the lower Lake region, and thence eastward over Pennsylvania and New York to southern New England, and in a few other small and widely scattered areas. In portions of the Ohio Valley it was the wettest December in 70 years, and locally in Texas the precipitation for the month was the greatest of record for December, and in portions of Arizona and New Mexico there was some unusually heavy precipitation for a winter month. On the other hand precipitation was less than normal, and in some sections scanty, over the Atlantic Coast States from Virginia to Florida, from the upper Lakes westward, and generally over the Plateau and Pacific Coast

States. At points in northern California it was among the driest Decembers of record, and that State as a whole was unusually dry.

In Florida the precipitation was usually deficient to a considerable extent, particularly in the southern portions where drought, more or less severe, had prevailed since the second decade of October. At Miami, the total precipitation from October 21 to December 31 amounted to only 9 per cent of the normal for the period. This lack of precipitation, however, was beneficial rather than harmful in portions of the Everglades, permitting the low ground to dry out sufficiently for truckers to begin operations.

SNOWFALL.

The snowfall was almost as great as in any previous December over New Mexico, principally owing to the vigorous snowstorm which reached most of that State and considerable parts of adjoining States about the 10th. This snow blocked railway and highway traffic on most of the important roads. A few of the higher portions of the Northwest and part of the upper Mississippi Valley had somewhat more snowfall than the December average.

On the whole, the country had considerably less snow than usually comes at this season, and this was notably true of California and Nevada and of the States just north of the Ohio River. The Lake region and the Northeast, which are the snowiest districts of the eastern half, had less than normal, as did the northern Plains, and in these areas, as well as in the upper Mississippi Valley, most of the snow that occurred was during the final week. In the northwestern districts also the greater part of the snow came between Christmas and New Year's Day. As a result of these falls late in the month, the depth on ground when the month ended was not far from the average December condition in most portions of the country, but there was a serious shortage in the California mountains and most of the ground was bare from Illinois eastward to New Jersey and southeastern New York.

Chart VII indicates the distribution of the month's snowfall, and the inset chart shows the depths that remained on the 31st.

RELATIVE HUMIDITY.

Over most portions of California and in the adjacent parts of Nevada the general dryness of the month is indicated by the average relative humidity, which ranged from 5 to nearly 20 per cent less than normal. In Arizona, however, and thence eastward over the Gulf and South Atlantic States the relative humidity was everywhere above normal, and decidedly so in the more western portions. In other districts the relative humidity was not materially at variance with normal conditions.

SEVERE LOCAL STORMS, DECEMBER, 1923.

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A more complete statement will appear in the annual report of the Chief of Bureau.]

Place.	Date.	Time.	Width of path.	Loss of life.	Value of property destroyed.	Character of storm.	Remarks.	Authority.
			Yards.					
Puget Sound, Wash. (near Friday Harbor).	5	P. m.				Gale	Steamer foundered and crew of 15 believed lost.	Star (Seattle, Wash.).
Oregon coast	5-6					Wind and rain	Considerable property damage. Communication and traffic interrupted.	Telegram (Portland, Oreg.).
Northern Idaho and northeastern Washington.	5-6					Wind, rain, and snow.	Telephone poles and trees blown down; traffic tied up and many towns isolated.	Chronicle (Spokane, Wash.).
Binghamton, N. Y.	6					Wind	Limbs blown from trees, electric light poles, windows, and globes broken; other property damage.	Press (Binghamton, N. Y.).
New Mexico (greater portion of).	10-11			14	$200,000	Heavy snowstorm followed by severe cold.	Some livestock lost and traffic tied up. A number of persons were frozen to death.	Official, U. S. Weather Bureau.
Coos Bay, Oreg.	16			9		Wind	Steamer wrecked	Roseburg News Review (Oregon).
Washington and Oregon coasts.	25					High winds	Considerable damage to roofs, plate-glass windows, telephones, wires and poles. Shipping delayed.	Official, U. S. Weather Bureau Bulletin (San Francisco, Calif.).

STORM AND WEATHER WARNINGS.

WASHINGTON FORECAST DISTRICT.

Storm warnings were issued in connection with five storms for the Middle Atlantic and North Atlantic coast and all were fully verified, except the warnings issued on the night of the 30th. The first warnings of the month were displayed the night of the 4th, at which time a disturbance of considerable intensity was central over Kentucky and moving northeastward. This storm moved very slowly during the ensuing 36 hours, but it increased in both area and intensity. There were gales along the entire seaboard from Cape Hatteras northward, and the highest velocity reported was 60 miles an hour from the southeast at Atlantic City, N. J.

The next storm of importance to cross the country was central over northern Ontario on the morning of the 13th, and a trough of low pressure extended thence southward to the Gulf coast. Southwest storm warnings were ordered displayed at all stations from Cape Hatteras northward and gales were general during the afternoon and night of the 13th. A maximum wind of 60 miles an hour from the south occurred at Atlantic City, N. J., and the same velocity from the north at Cape Henry, Va.

The next warnings were issued for the coast from Delaware Breakwater northward in connection with a disturbance that moved rapidly eastward from Ontario to Nova Scotia during the 16th–17th. The highest wind velocity reported was 56 miles an hour from the northwest at Block Island, R. I.

A disturbance that was central over Iowa on the morning of the 27th moved rapidly east-northeastward to Nova Scotia and Newfoundland during the next two days. It increased greatly in intensity and was attended by gales almost generally along the coast from Wil-